Atti Soc. ital. Sci. nat. Museo civ. Stor. nat. Milano, 129 (2-3): 139-145, 15-IX-1988

Anna Alessandrello, Giovanni Pinna & Giorgio Teruzzi (*)

LAND PLANARIAN LOCOMOTION TRAIL FROM THE LOWER PERMIAN OF LOMBARDIAN PRE-ALPS

(*Tricladida Terricola*)

Abstract. — We describe here a locomotion trail assigned to a land planarian found on a slab from the Lower Permian of Pre-Alps in Lombardy (Collio Formation, Alta Val Brembana, Bergamo). This is the first recording of fossil remains which can be assigned to land planarians. They are assigned to *Terricolichnus permicus*, new ichnogenus and new ichnospecies.

Key words: Permian, fossil trails, land planarians.

Zusammenfassung. — *Landplanarie Fortbewegungsfahrte aus dem Unterperm der lombardischen Voralpen* (Tricladida Terricola).

Man beschreibt hier eine zu einer Landplanarie zugeschriebenen Fortbewegungsfahrte, die auf eine Platte aus dem Unteren Perm der lombardischen Voralpen (Formation von Collio, Alta Val Brembana, Bergamo) gefunden wurde. Es sind die ersten beobachteten zu Landplanarien zuschreibbaren fossilen Resten, die hier als *Terricolichnus permicus*, neuer Ichnogenus und neue Ichnospezies, geschrieben werden.

Riassunto. — *Tracce di locomozione di una planaria terrestre del Permiano inferiore delle Prealpi lombarde* (Tricladida Terricola).

Viene descritta una pista di locomozione attribuita ad una planaria terrestre rinvenuta su una lastra proveniente dal Permiano inferiore delle Prealpi lombarde (Formazione di Collio, Alta Val Brembana, Bergamo). Si tratta della prima segnalazione di resti fossili attribuibili a planarie terrestri, che vengono attribuiti a *Terricolichnus permicus*, nuovo icnogenere e nuova icnospecie.

Introduction.

We analyze here a group of very peculiar imprints discovered on a grey-green siltstone slab coming from the Permian Collio Formation, in Valle del Scioc (Alta Val Brembana, Bergamo), from an outcrop which had already been recorded by Casati & Gnaccolini (1967).

(*) Museo Civico di Storia Naturale, Corso Venezia 55, 20121 Milano.

The Collio Formation, of continental origin, outcrops in the Pre-Alps of Lombardy in the provinces of Bergamo and Brescia. Its geological and sedimentological characteristics were thoroughly described for some typical outcrops areas: in the Alta Val Brembana (Bergamo) (CASATI & GNACCOLINI, 1967) and in the type area of the Alta Val Trompia (Brescia) (CASSINIS, 1966a and 1966b).

In its basal part, this formation features volcanic rocks (porphyrites, quartz-porphyrites, pyroclastites and tuffs) followed by sedimentary rocks, mainly fluvio-lacustrine sandstone and silstone, that sometimes alternate with levels of pyroclastic material and black shales. In addition, conglomeratic sandstones alternate locally with conglomerates.

In the arenaceous and siltitic members of the Collio Formation, there have been several recordings of fossiliferous levels containing vegetal and animal remains, as well as imprints of invertebrates and vertebrates.

Among vegetal forms, the genera *Walchia*, *Lebachia*, *Schizopteris* and *Noeggerathia* were recorded (GEINITZ, 1869; CURIONI, 1860; CASSINIS, 1966 a e b; CASATI & GNACCOLINI, 1966), whereas the only invertebrates to be found there where fresh water lamellibranches assigned to the genus *Anthraconaia*? by CASSINIS (1969).

Not fully analyzed in its particular aspects even if quite plentiful and well differentiated, the ichnofauna is represented by some trails of tetrapods and invertebrates preserved on the beds surface.

The first tetrapods' imprints were discovered by CURIONI & RAGAZZONI (1856), whereas short studies on the attribution of some specimens from Val Trompia and from the Prealpi Orobiche were published by CURIONI (1870) and DOZY (1935). The latter, in particular, described two new ichnospecies: *Anhomoiichnium orobicum* and *Onychichnium escheri*. The first was assigned to a lepidosaurian reptile, and the second to a reptile whose affinities are unknown. On the stratification planes, CASATI (1969) noticed the presence of tracks to be ascribed to invertebrates, and of biological structures that pass through the beds and therefore interrupt their original lamination.

The Collio Formation is assigned to the Lower Permian because of the paleobotanical contents of the siltitic and arenaceous members, and also because of its position in relation with the underlying formation (Basamento Cristallino and Conglomerato di base) and with the overlying formation (Verrucano Lombardo).

Depositional environment of fossiliferous levels.

The depositional environment of Collio Formation sedimentary rocks was discussed in several works (CASSINIS, 1966a & b; CASATI & GNACCO-

LINI, 1967; CASATI, 1969). The siltitic and arenaceous levels are supposed to have settled on the bottom of large endhoreic basin under the effect of streams loaded with silt and sand (CASSINIS, 1966b). The marked basin subsidence and the large quantity of soil transported there built up very thick amount of sedimentary material, to a thickness about 500 m in the typical section of Val Trompia. The presence of different siltitic levels featuring dessiccation sedimentary structures (mud cracks), along with imprints of raindrops and tetrapods' and invertebrates' trails indicates that some marginal areas of the basin itself may have been temporarily emerged on and off. The frequent occurrence of such levels, as those observed by ourselves in the outcrop of Valle del Scioc, leads us to think that such emergence phenomena were due to the alternation of dry and humid, rainy seasons. Probably, the imprints were led in the mud, that had just sunk, while it was still damp, and that got hard soon afterwards.

Description of the material.

The imprints bearing slab analyzed by us was found together with more other grey-green siltstone slabs coming from the same level. The surface of these slabs preserves vegetal remains, which can be assigned to the genus *Walchia*, as well as different types of imprints. Among them it is possible to identify sequences of imprints of small reptiles, trails of crawling invertebrates and marks left by raindrops.

Near a series of reptiles' imprints, assigned to the genus *Erpetopus* Moodie, 1929 (TONIUTTI, 1985), and some raindrop marks, on the slab here observed is clearly recognizable a sketched sequence of elongated imprints individually arranged in indian row. This sequence includes at least thirty-five short incisions, and most of them are curved (Fig. 1). The length of the individual incisions ranges from 1 mm to 1.02 mm, whereas the maximum width is 0.1 mm approximately. Each segment is about 0.5 mm from the next.

The peculiarity of this imprints is that they never match, or they do only accidentally: instead they follow one another so as to create one linear sequence. Though such sequence can be explained, due to its regular pattern, as an animal locomotion trail, nevertheless it cannot be ascribed — on the basis of its characteristics — to any organism with paired limbs or to any crawling animal.

At present, we know only one animal group, whose locomotion system can produce such trail type: land planarians (*Tricladida, Terricola*).

Locomotion of land planarians.

The majority of land planarians of present days lives in tropical and subtropical regions. The main exception is the family *Rhyncodemidae*, that has worldwide distribution but for Antartic and Artic regions. Many forms stemming from tropical and subtropical areas have spread to the humid environments of temperate regions, where they were introduced by chance following the import of exotic plants. Land planarian have vermiform, elongated bodies; the body is flat during rest, but its section will become elliptical or circular when the animal is on the move. The body length varies from less than 10 cm to more than 60 cm. They are nigth predators, that in daytime seek refuge under heaps of vegetables, fallen tree-trunks and stones. Even if they require a very humid environment, they cannot survive in water.

The complex mechanisms involved in the locomotion of land planarians have been studied recently by PANTIN (1950), JONES (1978) and MINELLI (1981).

The locomotion mechanism of these organisms varies according to their pace and the substrate characteristics. A typical locomotion mechanism of land planarians takes advantage of the presence of myopodia, i.e. muscular extroflections that develop along the inner ventral surface of the animal's body accompanied by mucus secretion. Myopodia are produced by peristaltic waves going backwards, that is opposit to the direction of the movement. In this case, the ventral surface of the planarian's body touches against the soil only in some points, that is in those coinciding with myopodial extremities. When the animal is on the move, these are therefore the only structures in contact with the substrate. The myopodia lie still with respect to the soil, and the planarian moves like a caterpillar belt.

The locomotion trail produced by such motion was suggested by PANTIN (1950) who reproduced the mucus trail left by *Rhyncodemus*; a similar trail was described by MINELLI (1981) also for the genus *Microplana*. It consists of a linear sequence and corresponds perfectly to the fossil sequence under examination. In living organisms, the development of individual tracks is not perflectly rectilinear but slightly curved. According to Minelli (1981), this features can be attributed to a locomotory component o non-peristaltic muscular type, that during motion generates lateral oscillations of the body. The result of these oscillations can also be seen in the fossil tracks, where each imprint is slightly curved.

Conclusions.

In view of the elements above illustrated, we believe there can be no question that the fossil sequence here observed is to be ascribed to the movement of a land planarian. The original warm, humid climate and the presence of vegetal remains on the layer surface probabily produced a habitat very similar to that where land planarians live today.

On the basis of the imprints we found, we can state that the adaptation of the Turbellaria to the subaerial environment dates back at least to the Lower Permian. We give the imprint here analyzed the specific name of

Terricolichnus permicus nov. ichnogen. nov. ichnosp.

Ichnogen. **Terricolichnus** nov.

Derivatio nominis: from the planarian order Terricola.

Type species: *Terricolichnus permicus.*

Diagnosis: coinciding with that of the type species.

Terricolichnus permicus nov. ichnosp.

Derivatio nominis: from its Permian age.

Holotype: n. cat. i8536, Coll. Museo Civico di Storia Naturale di Milano.

Type Locality: Val del Scioc (Alta Val Brembana, Bergamo).

Geological age: Lower Permian.

Diagnosis: linear sequence of individual elongated imprints with a curved shape. The length of each imprint ranges from 1 mm to 1.02 mm; the maximum observed width is about 0.1 mm.

Observations. The attribution to a terrestrial planarian of this peculiar kind of tracks is based, as already pointed out (this work, p. 141), on their perfect fittness with locomotion trails of some living planarians, as illustrated by PANTIN (1950, Pl. 2, fig. 6, 7). We discarded other possible and apparently simpler explanations, such as due to the movements of the tail of a swimming tetrapod or to the swings of the shell of a crawling snail, as not fitting with the ichnological characteristics of the trail.

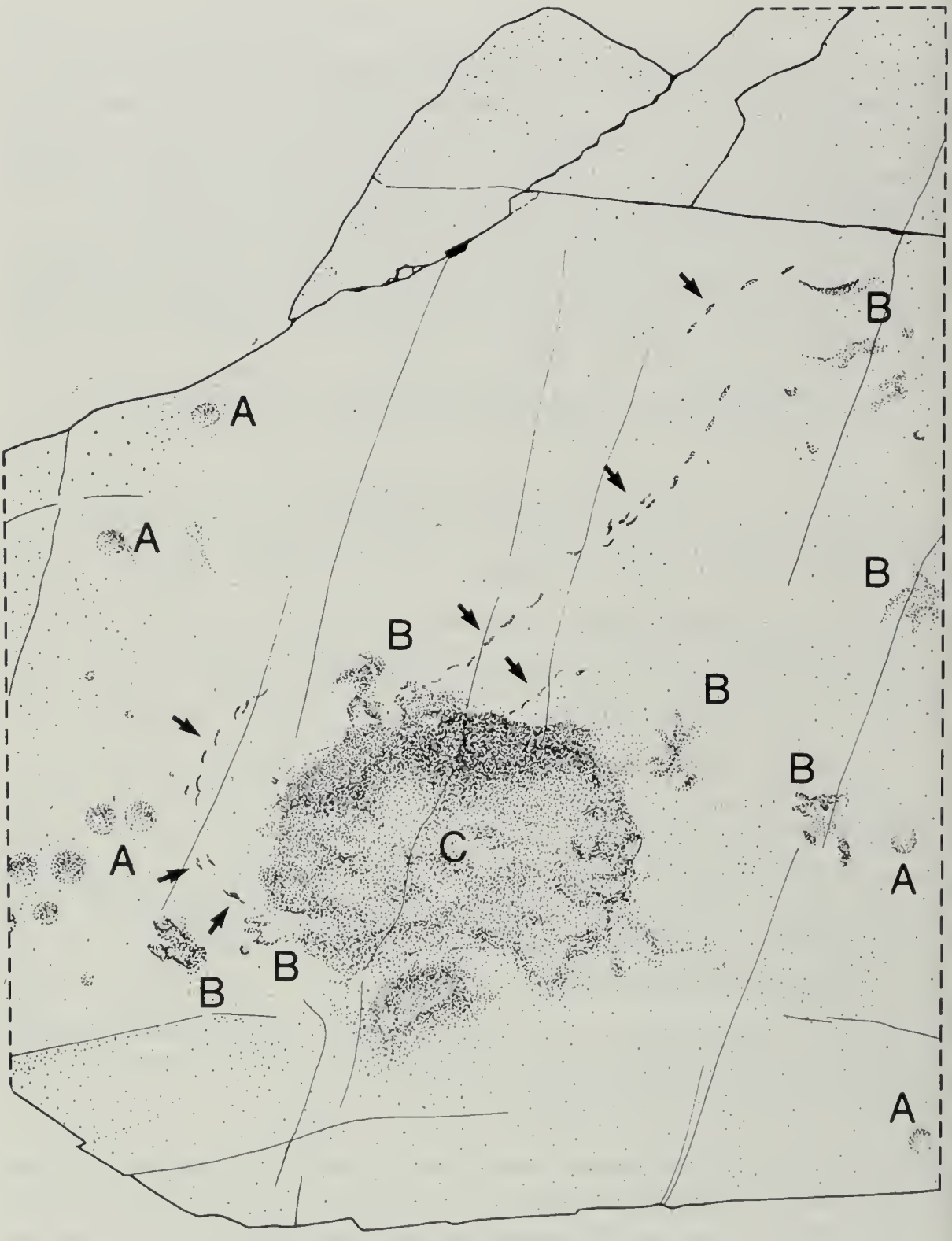

Fig. 1. — *Terricolichnus permicus* nov. iehnogen. nov. ichnosp. Drawing of part of the slab containing the planarian traeks indieated by arrows. A) Traces of raindrops; B) Footprints of different reptiles; C) Hollow cast of possible vegetal remains. The orientation is the same of Plate XIII.

Plate XIII. — Partial view of the slab with planarian tracks. N. cat. i8536 (× 2 ca.). Light direction indicated by white arrow.